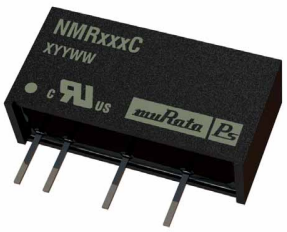
Murata Power Solutions

NMR Series

Isolated 1W Single Output DC-DC Converters



FEATURES

- Short circuit protection option
- UL 60950 recognised
- 1kVDC isolation 'Hi Pot Test'
- Wide temperature performance at full 1 watt load, –40°C to 85°C
- Industry standard pinout
- 5V, 12V & 24V inputs
- 5V, 12V & 15V outputs
- Fully encapsulated with toroidal magnetics
- Custom solutions available
- No electrolytic or tantalum capacitors

DESCRIPTION

The NMR series of industrial temperature range DC-DC converters are the standard building blocks for on-board distributed power systems. They are ideally suited for providing single rail supplies on primarily digital boards with the added benefit of galvanic isolation to reduce switching noise. Surface mount technology and advanced packaging materials produce rugged reliable performance over an extended temperature range from -40ºC to 85ºC. For the NMR100PC protection is continuous and auto-resetting on removal of the short circuit.

SELECTION GUIDE

Order Code	Nominal Input Voltage	Output Voltage	Output Current	Input Current at Rated Load	Load Regulation		Ripple & Noise[3]		Efficiency (Min)	Efficiency (Typ)	Isolation Capacitance	MTTF[1]		Recommended Alternative
	V	V	mA	mA	% Typ.	% Max.	mV p-p Typ.	mV p-p Max.	%		pF	MIL. kHrs	Tel. kHrs	
Recommended / In Production														
NMR100C	5	5	200	290	12	14	6	10		69	28	1847		
NMR101C	5	12	83	260	6.9	7.7	4.6	10		77	33	981		
NMR102C	5	15	67	253	6.5	7.5	4.3	10		79	40	667		
NMR106C	12	5	200	121	12.5	13.4	5.3	10		69	36	1485		
NMR107C	12	12	83	110	6.9	7.7	5	10		76	58	869		
NMR108C	12	15	67	110	6.5	7.5	4	10		76	56	613		
NMR118C	24	5	200	60	6.8	10	8	15		70	61	1253		
NMR119C	24	12	83	53	2.8	4	7	15		78	98	784		
NMR120C	24	15	67	52	2.5	3.5	8	15		80	122	566		
Short Circuit Protection Option														
NMR100PC	5	5	200	255	10	12	10	25	74	76.5	22	3095	61060	
Discontinued														
NMR112C	15	5	200	93	8.1	10	14	20		69	27	2110		MER1S1505SC
NMR113C	15	12	83	85	3.3	4	12	15		77	58	1790		MER1S1512SC
NMR114C	15	15	67	84	2.8	3.5	14	20		78	67	1560		MER1S1515SC

INPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Voltage range	Continuous operation, 5V input types	4.5	5	5.5	V
	Continuous operation, 12V input types	10.8	12	13.2	
	Continuous operation, 15V input types	13.5	15	16.5	
	Continuous operation, 24V input types	21.6	24	26.4	
Input short circuit current	Short circuit variants		95		mA
Input reflected ripple current	Short circuit types		2	15	mA p-p
	5V & 12V input types		1.6	2	
	15V & 24V input types		5	10	

OUTPUT CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Rated Power[2]	T_A=-40°C to 85°C, See derating graph			1.0	W
Voltage Set Point Accuracy	See tolerance envelope				
Line regulation	High V_{IN} to low V_{IN} ; Short circuit types		1.15	1.2	%/%
	High V_{IN} to low V_{IN} ; All other output types		1.0	1.2	

ISOLATION CHARACTERISTICS

Parameter	Conditions	Min.	Typ.	Max.	Units
Isolation voltage	Flash tested for 1 second	1000			VDC
Resistance	Viso=1000VDC	10			GΩ

RoHS COMPLIANT

25 For full details go to www.murata-ps.com/rohs

c UL us

1. Calculated using MIL-HDBK-217 FN2 and Telcordia SR-332 calculation model with nominal input voltage at full load.
2. See derating graph.
3. See ripple & noise characterisation method.

All specifications typical at T_A=25°C, nominal input voltage and rated output current unless otherwise specified.

ABSOLUTE MAXIMUM RATINGS	
Lead temperature 1.5mm from case for 10 seconds	260°C
Wave Solder	Wave Solder profile not to exceed the profile recommended in IEC 61760-1 Section 6.1.3. Please refer to application notes for further information.
Input voltage V_{IN}, NMR100C, NMR101C, NMR102C	7V
Input voltage V_{IN}, NMR106C, NMR107C, NMR108C	15V
Input voltage V_{IN}, NMR112C, NMR113C, NMR114C	18V
Input voltage V_{IN}, NMR118C, NMR119C, NMR120C	28V

GENERAL CHARACTERISTICS					
Parameter	Conditions	Min.	Typ.	Max.	Units
Switching frequency	5V input types		110		kHz
	12V input types		160		
	15V input types		90		
	24V input types		80		
	Short circuit types		97		

TEMPERATURE CHARACTERISTICS					
Parameter	Conditions	Min.	Typ.	Max.	Units
Specification	All output types	-40		85	°C
Storage		-50		130	
Case Temperature above ambient	5V output types		33		
	All other output types		28		
	Short circuit types		18		
Cooling	Free air convection				

TECHNICAL NOTES

ISOLATION VOLTAGE

'Hi Pot Test', 'Flash Tested', 'Withstand Voltage', 'Proof Voltage', 'Dielectric Withstand Voltage' & 'Isolation Test Voltage' are all terms that relate to the same thing, a test voltage, applied for a specified time, across a component designed to provide electrical isolation, to verify the integrity of that isolation.

Murata Power Solutions NMR series of DC-DC converters are all 100% production tested at their stated isolation voltage. This is 1kVDC for 1 second.

A question commonly asked is, "What is the continuous voltage that can be applied across the part in normal operation?"

The NMR is recognised by Underwriters Laboratory for functional insulation, both input and output should normally be maintained within SELV limits i.e. less than 42.4V peak, or 60VDC. The isolation test voltage represents a measure of immunity to transient voltages and the part should never be used as an element of a safety isolation system. The part could be expected to function correctly with several hundred volts offset applied continuously across the isolation barrier; but then the circuitry on both sides of the barrier must be regarded as operating at an unsafe voltage and further isolation/insulation systems must form a barrier between these circuits and any user-accessible circuitry according to safety standard requirements.

REPEATED HIGH-VOLTAGE ISOLATION TESTING

It is well known that repeated high-voltage isolation testing of a barrier component can actually degrade isolation capability, to a lesser or greater degree depending on materials, construction and environment. The NMR series has toroidal isolation transformers, with no additional insulation between primary and secondary windings of enamelled wire. While parts can be expected to withstand several times the stated test voltage, the isolation capability does depend on the wire insulation. Any material, including this enamel (typically polyurethane) is susceptible to eventual chemical degradation when subject to very high applied voltages thus implying that the number of tests should be strictly limited. We therefore strongly advise against repeated high voltage isolation testing, but if it is absolutely required, that the voltage be reduced by 20% from specified test voltage.

This consideration equally applies to agency recognised parts rated for better than functional isolation where the wire enamel insulation is always supplemented by a further insulation system of physical spacing or barriers.

SAFETY APPROVAL

UL60950

The NMR series is recognised by Underwriters Laboratory (UL) to UL 60950 for functional insulation in a maximum still air ambient temperature of 100°C as measured at any point on the case of the unit (hotspot).

FUSING

The NMR Series of converters are not internally fused so to meet the requirements of UL an anti-surge input line fuse should always be used with ratings as defined below.
Input Voltage, 5V 0.5A
Input Voltage, 12V 0.25A
Input Voltage, 24V 0.12A

All fuses should be UL recognised, 125V rated.
File number E151252 applies.

RoHS COMPLIANCE INFORMATION

RoHS COMPLIANT

This series is compatible with RoHS soldering systems with a peak wave solder temperature of 260ºC for 10 seconds. Please refer to application notes for further information. The pin termination finish on this product series is Tin Plate, Hot Dipped over Matte Tin with Nickel Preplate. The series is backward compatible with Sn/Pb soldering systems.
For further information, please visit www.murata-ps.com/rohs

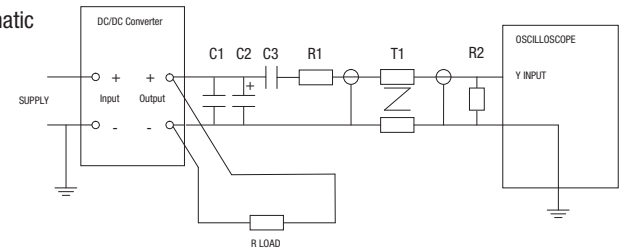
CHARACTERISATION TEST METHODS

Ripple & Noise Characterisation Method

Ripple and noise measurements are performed with the following test configuration.

C1	1µF X7R multilayer ceramic capacitor, voltage rating to be a minimum of 3 times the output voltage of the DC-DC converter
C2	10µF tantalum capacitor, voltage rating to be a minimum of 1.5 times the output voltage of the DC-DC converter with an ESR of less than 100mΩ at 100 kHz
C3	100nF multilayer ceramic capacitor, general purpose
R1	450Ω resistor, carbon film, ±1% tolerance
R2	50Ω BNC termination
T1	3T of the coax cable through a ferrite toroid
RLOAD	Resistive load to the maximum power rating of the DC-DC converter. Connections should be made via twisted wires
Measured values are multiplied by 10 to obtain the specified values.	

Differential Mode Noise Test Schematic



APPLICATION NOTES

Minimum load

The minimum load to meet datasheet specification is 10% of the full rated load across the specified input voltage range. Lower than 10% minimum loading will result in an increase in output voltage, which may rise to typically double the specified output voltage if the output load falls to less than 5%.

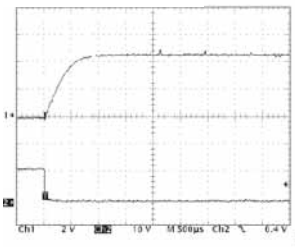
Capacitive loading and start up

Typical start up times for this series, with a typical input voltage rise time of 2.2µs and output capacitance of 10µF, are shown in the table below. The product series will start into a capacitance of 47µF with an increased start time, however, the maximum recommended output capacitance is 10µF.

	Start-up time µs
NMR100C	2301
NMR101C	5570
NMR102C	8289
NMR106C	783
NMR107C	4770
NMR108C	4850

	Start-up time µs
NMR112C	744
NMR113C	1908
NMR114C	6620
NMR118C	671
NMR119C	5335
NMR120C	6370
NMR100PC	360

Typical Start-Up Wave Form



APPLICATION NOTES (Continued)

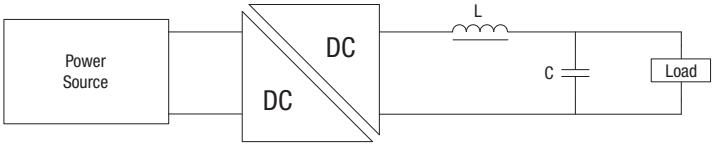
Output Ripple Reduction

By using the values of inductance and capacitance stated, the output ripple at the rated load is lowered to 5mV p-p max.

Component selection

Capacitor: It is required that the ESR (Equivalent Series Resistance) should be as low as possible, ceramic types are recommended.
The voltage rating should be at least twice (except for 15V output), the rated output voltage of the DC-DC converter.

Inductor: The rated current of the inductor should not be less than that of the output of the DC-DC converter. At the rated current, the DC resistance of the inductor should be such that the voltage drop across the inductor is <2% of the rated voltage of the DC-DC converter. The SRF (Self Resonant Frequency) should be >20MHz.

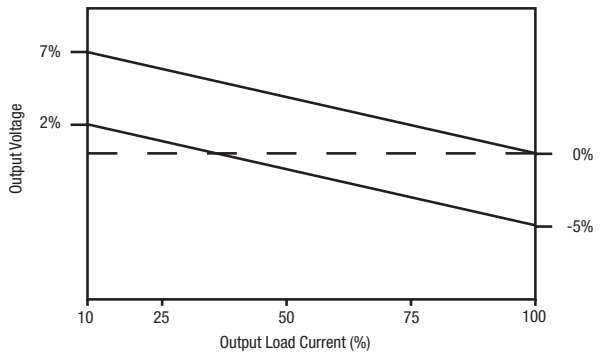


	Inductor			Capacitor
	L, µH	SMD	Through Hole	C, µF
NMR100C	10	82103C	11R103C	4.7
NMR101C	47	82473C	11R473C	1
NMR102C	47	82473C	11R473C	1
NMR106C	10	82103C	11R103C	4.7
NMR107C	47	82473C	11R473C	1
NMR108C	47	82473C	11R473C	1
NMR112C	10	82103C	11R103C	4.7
NMR113C	47	82473C	11R473C	1
NMR114C	47	82473C	11R473C	1
NMR118C	10	82103C	11R103C	4.7
NMR119C	47	82473C	11R473C	1
NMR120C	47	82473C	11R473C	1
NMR100PC	22	82223C	11R223C	1

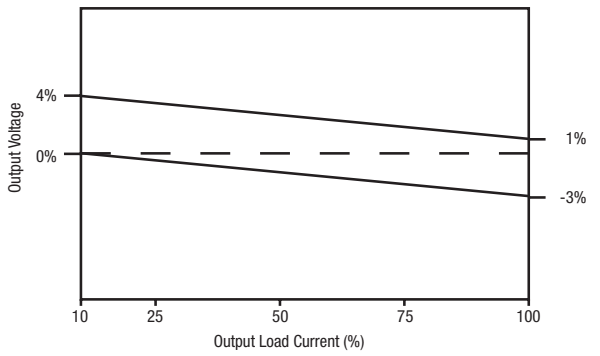
TOLERANCE ENVELOPES

The voltage tolerance envelopes show typical load regulation characteristics for this product series. The tolerance envelope is the maximum output voltage variation due to changes in output loading and set point accuracy.

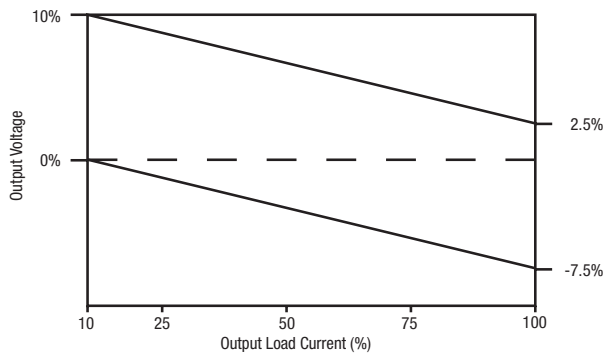
NMR118



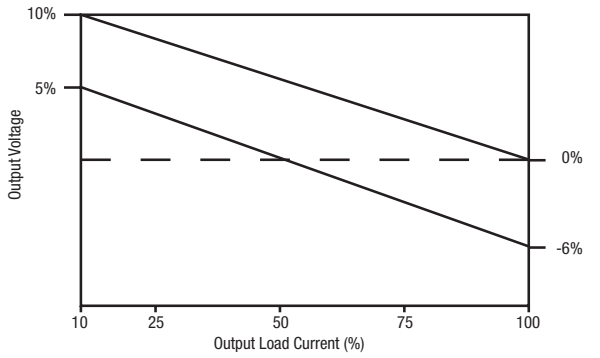
NMR113, NMR114, NMR119, NMR120



All other output types

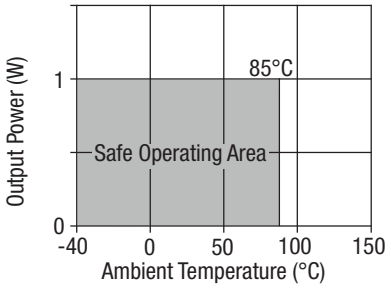


Short cicuit types

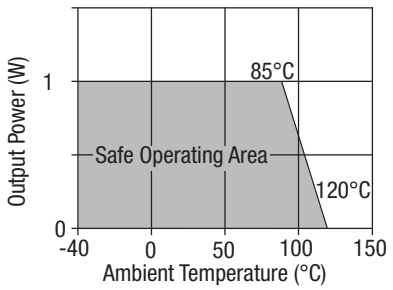


TEMPERATURE DERATING GRAPHS

Short Circuit types.



All other types.



EFFICIENCY VS LOAD

NMR100C

NMR101C

NMR102

NMR106C

NMR107C

NMR108C

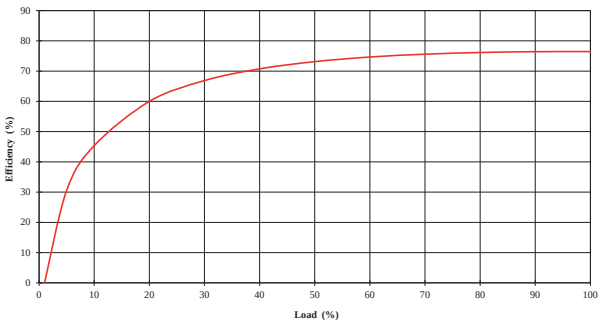
EFFICIENCY VS LOAD (Continued)

NMR118C

NMR119C

NMR120C

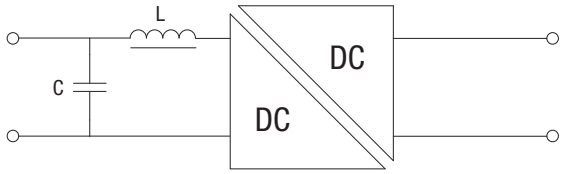
NMR100PC



EMC FILTERING AND SPECTRA

FILTERING

The following filter circuit and filter table shows the input filters typically required to meet EN 55022 Curve B, Quasi-Peak EMC limit, as shown in the following plots. The following plots show positive and negative quasi peak and CISPR22 Average Limit B (pink line) and Quasi Peak Limit B (green line) adherence limits.



C Ceramic capacitor

	Inductor			Capacitor
Part Number	L, µH	SMD	Through Hole	C, µF
NMR100C				
NMR101C				
NMR102C				
NMR106C				
NMR107C				
NMR108C				
NMR118C				
NMR119C				
NMR120C				
NMR100PC	10	82103C	13R103C	10

NMR100C

NMR101C

NMR102C

NMR106C

EMC FILTERING AND SPECTRA (Continued)

NMR107C

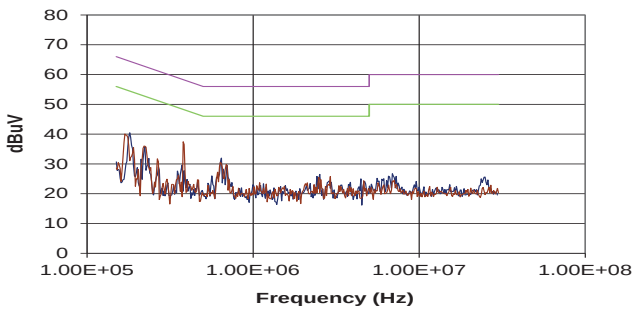
NMR108C

NMR118C

NMR119C

NMR120C

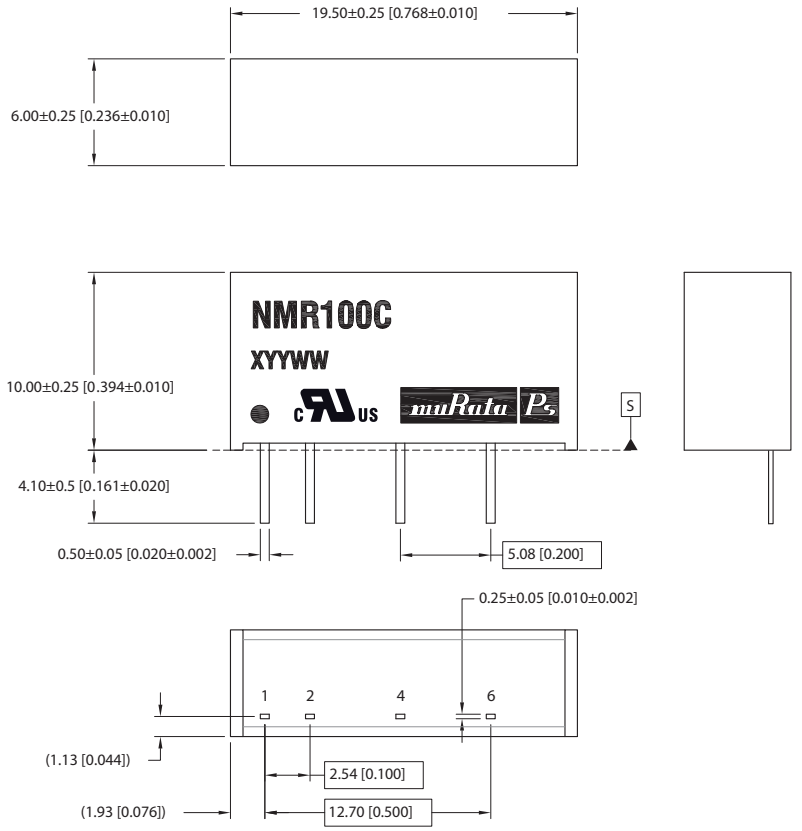
NMR100PC



PACKAGE SPECIFICATIONS

MECHANICAL DIMENSIONS

7 Pin SIP Package



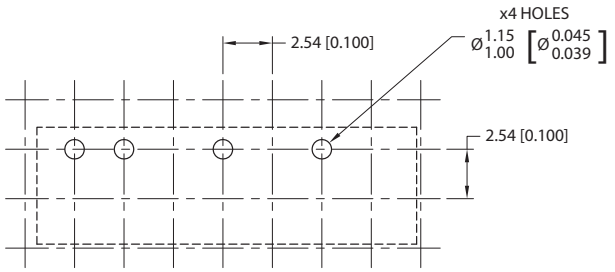
All dimensions in mm (inches) Controlling dimension is mm.
All pins on a 2.54 (0.100) pitch and within ±0.1 (0.004) of true position from pin 1 at seating plane 'S'

Weight: 2.1g (C) 1.9g (PC)

PIN CONNECTIONS - 7 PIN SIP

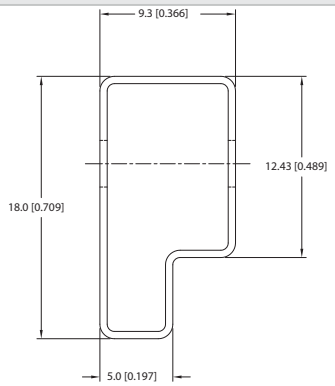
Pin	Function
1	$+V_{IN}$
2	$-V_{IN}$
4	$-V_{OUT}$
6	$+V_{OUT}$

RECOMMENDED FOOTPRINT DETAILS



All dimensions in mm (inches) Controlling dimension is mm.

TUBE OUTLINE DIMENSIONS



Unless otherwise specified all dimensions in mm [inches] ±0.55mm [0.022].
Tube Length : 520mm [20.472] ±2.0 [0.079].

Tube quantity: 35

DISCLAIMER

Unless otherwise stated in the datasheet, all products are designed for standard commercial and industrial applications and NOT for safety-critical and/or life-critical applications.

Particularly for safety-critical and/or life-critical applications, i.e. applications that may directly endanger or cause the loss of life, inflict bodily harm and/or loss or severe damage to equipment/property, and severely harm the environment, a prior explicit written approval from Murata is strictly required. Any use of Murata standard products for any safety-critical, life-critical or any related applications without any prior explicit written approval from Murata shall be deemed unauthorised use.

These applications include but are not limited to:

- Aircraft equipment
- Aerospace equipment
- Undersea equipment
- Power plant control equipment
- Medical equipment
- Transportation equipment (automobiles, trains, ships, etc.)
- Traffic signal equipment
- Disaster prevention / crime prevention equipment
- Data Processing equipment

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Refer to: https://www.murata.com/en-eu/products/power/requirements